

My view of our planet was a glimpse of divinity.

Edgar Mitchell, U.S. astronaut

AIR POLLUTION

Floral Scents Going Off the Air?

Would a flower by any other name always smell as sweet? Maybe not, if air pollution has anything to do with it. Researchers at the University of Virginia in Charlottesville report that three common constituents of smog destroy floral scents released by flowers to attract bees and other pollinators. In fact, flower scents traveled four times farther in the 1840s, when European scientists first began documenting ozone pollution, than they do under today's air conditions, according to modeled simulations run by the researchers. Because pollinating insects rely partly on scents to find flowers, the loss of fragrant plumes could make it harder for insects to locate pollen sources, jeopardizing pollinators and crops alike. The researchers are beginning field trials this month to see if real-world tracking of airborne floral scents match the results predicted by the model.

The vitality of plants depends on pollination, according to principal investigator Jose Fuentes, a meteorologist. Additionally, if pollinators are forced to spend more time foraging for food yet collect less pollen to feed their young, insect colonies may suffer nutritionally. Both problems could impact our food supply. "We need to preserve pollinators because they provide useful services," Fuentes says.

It had already been established that when fragrance molecules wafting downwind meet up with air pollutants, chemical reactions alter the floral scents and contribute to production of compounds such as acetone, formaldehyde, and carbon monoxide. In the current study, Fuentes and colleagues Quinn McFrederick and James Kathilankal estimated the fate of three common volatile hydrocarbons emitted by flowers as they encountered increasing levels of ozone, hydroxyl radicals, and nitrate radicals. In the summer of 2002, the researchers measured temperature, wind turbulence, and other factors that determine the rate of floral scent emission and movement at an experimental farm in Virginia. They observed how these factors affected the release of scent from a plot of snapdragons that grew wild on the farm.

The researchers plugged these data into a model to test different air pollution scenarios ranging from conditions that prevailed during the 1840s to current summertime conditions in large eastern U.S. cities, where ozone levels can exceed 120 ppb by volume. Under 1840s conditions, only 20% of scents were altered by chemical reactions within a 1,000-meter radius downwind of the floral source. However, even slight

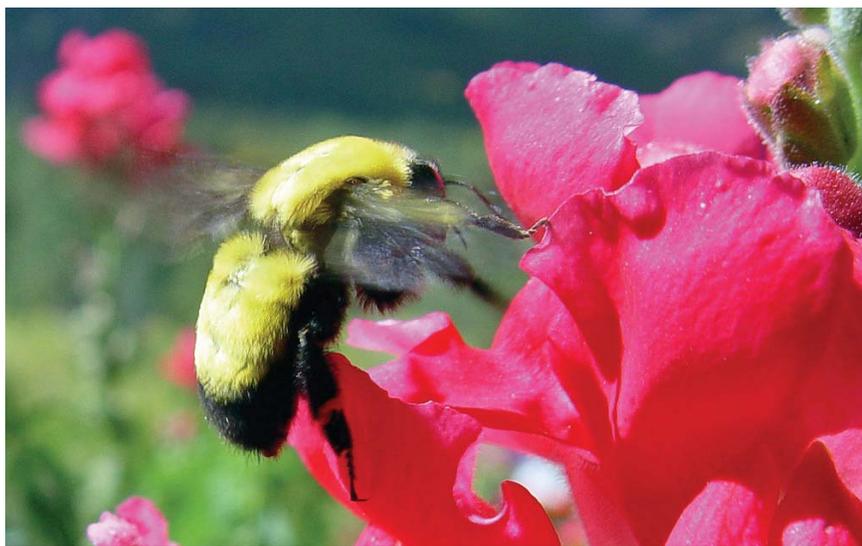
elevations in pollutants—comparable to air quality today in rural areas with little industrial emissions—altered more than 40% of the scents within a 500-meter radius of the floral source. In the most polluted scenario, only 25% of the scents survived 300 meters downwind. Fuentes and colleagues reported the findings in volume 42, issue 10 (March 2008) of *Atmospheric Environment*.

Do compounds generated when floral scents are chemically altered actually worsen air pollution? "We haven't thought about this in [terms of] air quality," Fuentes says. He says the findings also raise special concerns about the fate of nighttime pollinators such as moths, which rely largely on scent to find flowers (in contrast to bees, which use both color and scent during daytime).

Fuentes cautions against applying the new findings to colony collapse disorder (CCD), an unexplained phenomenon that has decimated bee colonies in the past two years. He says some of the best evidence to date suggests CCD is more directly related to infectious agents and pesticides. However, he says, any effects from air pollution "are probably an added stress that bees have to cope with."

Other insect behaviors that orient by chemical scents, such as beetles mating, also could be disturbed by air pollution. On the other hand, some plants may benefit from disrupted airborne signals: "If insects can't smell plants, they can't come to eat them," says Jay Evans, a research entomologist at the U.S. Department of Agriculture, who calls the Fuentes study "a beautiful mix of good ecology and chemistry."

Pollinators aren't the only species dealing with the olfactory effects of air pollution. In the January 2006 issue of *Chemical Senses*, Robyn Hudson and colleagues reported that residents of Mexico City, which has some of the world's worst air pollution, were significantly less able to detect and distinguish between food odors than were residents of Tlaxcala, a geographically similar area with much lower air pollution. The difference was observed in multiple age groups, even when smokers were removed from the analysis, strongly suggesting a link with pollutants that may damage the olfactory epithelium. —Carol Potera



Air pollutants interfere with pollinators' ability to locate flowers by scent

URBAN ISSUES

The Sprawl of Food Deserts

The North American urban landscape has changed considerably over the past few decades with the advent of the automobile as the transportation mode of choice. Privatized mobility allowed wealthier people to move outward from city centers toward the suburbs, and with them went many of the supermarkets that used to pervade urban areas. The steady suburbanization of major food retailers is contributing to the emergence of urban “food deserts,” areas within city centers where low-income people have poor access to vegetables, fruits, and other whole foods. Because many chronic diseases have been associated with low consumption of vegetables and fruits, along with high consumption of sugary or high-fat foods, urban food deserts may be taking a health toll on those who live in socially deprived neighborhoods.

Canadian researchers at The University of Western Ontario recently studied the evolution of food deserts since the 1960s in the mid-sized city of London, Ontario. They used a geographic information system (GIS) to map locations of supermarkets in 1961 and 2005. Then they assessed changes in supermarket access in relation to neighborhood location, socioeconomic characteristics, and access to public transit using multiple “network analysis” techniques, which take into account variations in how people are spaced and actually move throughout their environs.

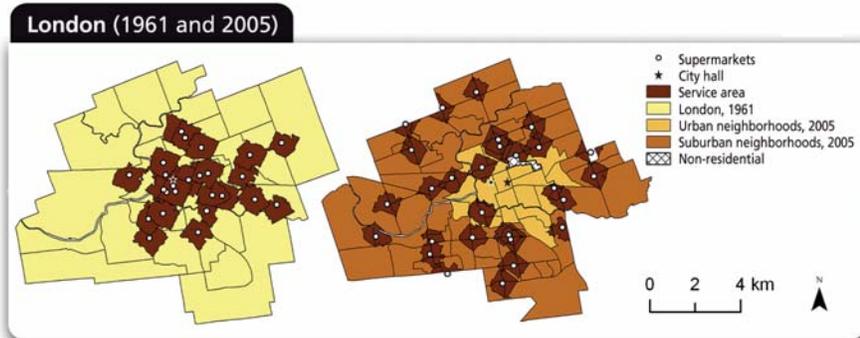
In an article published 18 April 2008 in the online *International Journal of Health Geographics*, the research team reported that low-income residents of London's inner-city neighborhoods had poorer access to supermarkets than middle- and high-income residents. Moreover, spatial inequalities in access



to supermarkets had increased over time. In 1961, more than 75% of London's inner-city population lived within 1 kilometer of a supermarket, giving them easy access to a variety of foods, says principal investigator Jason Gilliland, who directs the university's Urban Development Program. In 2005, he says, that number was less than 20%.

“One can say that this problem may only get worse in the near future, considering current concerns about rising food prices and food scarcity,” says Isaac Luginaah, Canada Research Chair in Health Geography at The University of Western Ontario. “[These] findings therefore require policy attention.”

Gilliland suggests several strategies for dealing with urban food deserts. To begin with, he says, cities should support planning policies that boost the inner-city population (e.g., better transportation, housing, and schools) while offering grocery retailers direct incentives (e.g., zoning allowances, tax holidays, or tax rebates) to locate downtown. City planners can also encourage smaller alternative food retailers, especially farmer's markets. For neighborhoods that cannot support a farmer's market every day, Gilliland suggests a “mobile market” that visits various neighborhoods throughout the week. For residents without a car, ride sharing and weekend shuttle bus services could



GIS mapping shows the outward migration of supermarkets in a mid-sized Canadian city

Source: Larsen K, Gilliland J. *Int J Health Geogr*. 2008 Apr 18;7:16. ©2008 Larsen and Gilliland; licensee BioMed Central Ltd.

ehpnet | by Erin E. Dooley

EPA–China Environmental Law Initiative

http://epa.gov/ogc/china/initiative_home.htm

China's recent rapid economic expansion has created an array of serious environmental problems for that country, which Chinese officials are working to rectify with a solid environmental law framework. But implementing such laws is not always easy. In the fall of 2007, after a series of meetings with organizations in several Chinese cities, the U.S. Environmental Protection Agency (EPA) General Counsel launched the EPA–China Environmental Law Initiative to facilitate discussion on ways to foster environmental legislation and regulation. Information about this program is available online in both English and Chinese.

Visitors will find links to the websites of the initiative's collaborators, all of whom have experience in Chinese environmental law and the environmental matters encountered by U.S. businesses operating in China. There is a Legal Resources page of information on Chinese environmental statutes, regulations, and directives as well as treaties and other international cooperation activities to which the country is party. Also on this page are links to recent reports and other publications pertinent to the scope of the initiative.

Recent relevant news articles are arranged on the homepage within subject headings that include pollution control, public participation, climate change/energy, and sustainability/pollution prevention. An archive of older items is also available. The homepage also features a calendar of upcoming events.

be explored to serve disadvantaged neighborhoods without a supermarket.

This is the first known historical analysis of how food deserts evolve over time, exploring empirically (and confirming) the assumption that pedestrians had easier access to grocery stores in the past, says Gilliland. “On the other hand,” he adds, “many people, including policy makers, may assume that accessibility is universal in the age of the automobile, without recognizing the problems faced by people without an automobile.”

Future studies will need to factor in car trips to supermarkets, which the London study did not do, says nutritional epidemiologist Margo Barker of the University of Sheffield School of Medicine and Biomedical Sciences. It remains to be seen, she adds, whether good access to a supermarket actually benefits food decisions and nutritional health, particularly for those most in need.

To improve future studies of these issues, Gilliland says it may be helpful to interview people who live in food deserts to better understand the psychological, economic, and personal effects of these settings. “After all,” he says, “the continued closure of supermarkets in disadvantaged areas will lead to more unemployment and likely have devastating effects on the health of an already vulnerable population.” —M. Nathaniel Mead

NANOTECHNOLOGY

Nano-Food Chain Link Examined

Engineered nanomaterials—materials and even machines constructed on a nanometer scale—have enormous potential in everything from electronics to textiles to medicine. Although nanomaterials are being manufactured in ever greater numbers, little is known about their biological effects, including whether they biomagnify as they travel up food chains. Now chemical engineer David Holbrook and colleagues at the U.S. National Institute of Standards and Technology report that certain nanomaterials may not accumulate in organisms at higher trophic levels. However, the researchers are quick to add that much more work is required before any generalizations can be made regarding environmental and human safety of nanomaterials.

Holbrook's team prepared an aqueous environment in the laboratory in which *Escherichia coli* provided a food source for the ciliate *Tetrahymena pyriformis*, which in turn provided a food source for the rotifer *Brachionus calyciflorus*. "This simple food chain represents what we might see in a real aquatic environment," explains Holbrook. The team then added two types of nanomaterial to their experimental environment: carboxylated and biotinylated quantum dots (QDs) made from cadmium, selenium, zinc and sulfate, whose fluorescing properties make them easy to detect microscopically.

The bacteria did not accumulate the QDs, although the ciliates did. Even so, both types of QDs accumulated at about 21–30% of the benchmark rate at which a pollutant is considered to be "very bioaccumulative."

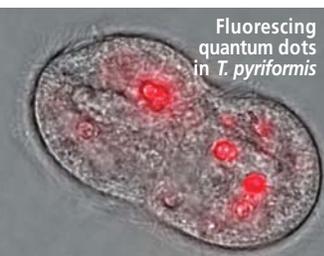
The researchers also observed that intact QDs appeared within the gut and body cavity of the rotifers. But whether a contaminant biomagnifies depends in part on how quickly an organism eliminates

the contaminant from its body. The researchers determined this rate by placing rotifers that had assimilated QDs into a clean environment, then measuring the fall in their QD content ("deuration") over time. Holbrook says the deuration rates observed were an order of magnitude higher than the threshold that predicts biomagnification.

However, the study results, which appear in the June 2008 issue of *Nature Nanotechnology*, are not proof that nanomaterials pose no environmental threat. "There are many types of nanomaterials, environments, organisms, and food chains—we have looked at just one type of each," says Holbrook. "These results are interesting, but extrapolating them very far, such as to natural systems, may not be prudent."

"More work of this type is essential," comments Robert Lee, a professor of law at Cardiff University, United Kingdom, and a member of the U.K. Nanotechnology Research Coordination Group. "More attention needs to be paid to the health risks possibly associated with different types of nanomaterial; data on toxicity is essential for governments to properly regulate their use. But information is vital for business, too, in addressing possible legal liability in the future. Companies manufacturing or using nanomaterials in their products need to track this type of work to avoid finding themselves liable for damages should nanoparticles be later shown to cause harm to human health or the environment."

"These are interesting findings," agrees Rosa Ortega, a professor of nutrition at Complutense University in Madrid, Spain, "but the properties of different nanomaterials, the different organisms in different food chains, environmental conditions, and how organisms break down different nanomaterials all influence whether they will be biomagnified. We need to continue work to ensure nanomaterials are safely used." —Adrian Burton



Fluorescing quantum dots in *T. pyriformis*

The Beat | by Erin E. Dooley

Will Beijing Clean Up in Time?

When Beijing made its bid in 2001 to become an Olympic host city, the city assured the International Olympic Committee that it would meet WHO standards for air pollution by the time the games commenced. As the event gears up for its August 2008 debut, the city has taken drastic measures in a last-ditch effort to reduce pollution levels and improve the air quality. For the past several weeks factories, construction sites, and concrete mixing plants have been shut down, and



Beijing, 18 March 2008

automobile traffic has been restricted since mid-July. It remains to be seen whether the city's air will be clean enough in time; Olympic officials warn that outdoor endurance events may be postponed if air quality is poor. The NIEHS has funded research to compare resident lung health before and after the Olympics cleanup.

Microbes Heat Up

Microbes perform a range of critical functions, such as helping regulate oxygen and greenhouse gases in the atmosphere, fixing nitrogen in soils required for plant growth, and converting waste matter to nutrients. Researchers reported at the June 2008 general meeting of the American Society for Microbiology that climate change is already affecting microbial communities in Alaska, where warmer temperatures are raising nitrogen availability in soils, possibly impacting fungal activity and diversity. Shorter freezing periods could also prevent molds that grow under the snow from retaining enough snowmelt, subjecting trees to drought.

Rice Not So Nice for Babies?

In many areas of the world, babies are weaned from the breast or bottle onto rice cereal and other rice-based foods. A study in volume 152,



issue 3 (2008) of *Environmental Pollution* finds that rice foods sold in Western supermarkets can contain high levels of inorganic arsenic—a baby eating 1 serving of rice cereal each day could take in more of this carcinogen per kilogram body weight than an adult exposed to the maximum allowance in drinking water. Arsenic levels in rice vary depending on where it is grown; the authors suggest using rice from sources in India, California, and Spain.

Lead in Artificial Turf

Environmental health advocates have recently begun to question the safety of artificial turf fields [see "Synthetic Turf: Health Debate Takes Root,"

PESTICIDES

In Search of a Better Mosquito Repellent

Insect bites are more than just an itchy nuisance; mosquitoes and ticks spread malaria, West Nile virus, Lyme disease, and other illnesses. The insect repellent DEET keeps insects away, but it wears off with sweat and can cause health problems in sensitive people, including rashes, skin and mucous membrane irritation, dizziness, headaches, disorientation, and nausea. Although DEET shows broad-spectrum activity against biting insects, it apparently does not work as well against malaria-carrying strains of mosquitoes. Finally, DEET smells bad, and it can damage plastic eyeglass lenses and watch faces. Now scientists are studying a new type of repellent that overcomes at least one of these myriad disadvantages, lasting three times longer than DEET.

For the past 60 years, the U.S. Department of Agriculture (USDA) has tested tens of thousands of chemicals as possible repellents and cataloged the results. Recently, researchers at the USDA Agricultural Research Service and the University of Florida evaluated the records of several hundred diverse compounds and focused on the most effective ones, all of which were acylpiperidines—chemical cousins of the compound piperidine, which gives black pepper its bite. They selected 11 compounds with confirmed effectiveness, and chemists in the group synthesized 23 more, guided by a computer model that predicts improved performance by altering chemical groups.

The mosquito-repelling potency of each compound was tested by volunteers who put their arms inside boxes filled with *Aedes aegypti* mosquitoes for 1 minute per compound per day, while the researchers recorded how many days it took to be bitten. Under these test conditions, the DEET treatment wore off after 17.5 days on average, whereas several of the test compounds lasted 40 to 50 days, and one remained active for 73 days. The results, reported in the 27 May 2008 issue of

the *Proceedings of the National Academy of Sciences*, “were just phenomenal,” says Ulrich Bernier, the USDA research chemist who conducted the bite tests.

Next, Bernier and colleagues will evaluate the effectiveness of the compounds against mosquitoes that transmit malaria, and then against other insect species. The best repellents will then be assessed for skin toxicity. “We hope the acylpiperidines are safer than DEET, but we don’t know yet,” says Bernier.

The same USDA chemical collection that contained the acylpiperidines also spawned DEET, which has been the reigning repellent since its commercialization in the 1950s. DEET is a very good repellent, says Bernier, despite its drawbacks. To be economically viable, any competitor not only must repel insects better than DEET, but also overcome its disadvantages. So why haven’t the newly identified compounds been pursued further in the past? Bernier explains that, efficacy-wise, “they were equal to or just a bit better than DEET. . . . It would not be advisable to spend millions of dollars just to introduce a repellent into the market that one advertises as ‘about as good as DEET.’”

“There’s always room for new and effective repellents, because consumers want a choice,” says Jonathan Day, a medical entomologist at the University of Florida in Vero Beach. Even during medical emergencies such as an outbreak of West Nile virus, some people refuse to use DEET, according to Day, and newer botanical formulations do not repel insects as well. The acylpiperidines look promising, but it’s a long road from identifying a potential repellent to registration with the Environmental Protection Agency. “Time will tell whether these compounds make it to store shelves,” Day says. —Carol Potera

EHP 116:A116–122 (2008)]. Now, after testing in New Jersey revealed high levels of lead on some artificial turf fields, the CDC has recommended that worn playing fields be tested for lead. Moreover, children under age 6 years should not be allowed to play on fields found to have lead levels exceeding 400 ppm. On 23 June 2008, the nonprofit Center for Environmental Health filed suit under California’s Proposition 65, calling for 15 companies to cease producing and selling artificial turf. Three days later the San Diego County Water Authority suspended an incentive program that offered a water bill rebate to

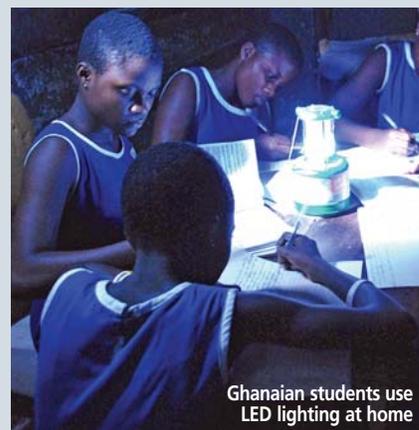
consumers who installed artificial turf lawns. The CPSC is investigating lead in artificial turf, with a report expected any day.

Globalization and Food Safety

The United States is increasingly importing more of its food—approximately 15% in 2006—from developing countries, which researchers at the June 2008 general meeting of the American Society for Microbiology warn have lower sanitary food production standards than those in the United States, especially for seafood and fresh produce. More than 80% of the seafood consumed in the United States is imported, mainly from Asia, where aquaculture practices often involve using raw domestic sewage or livestock manure as feed, as well as the use of pesticides and antibiotics not approved in the United States. The researchers point out that many U.S. companies take steps to verify that their imports have been produced under stringent sanitary conditions. The FDA inspects imported food, although on a limited basis—less than 1% of more than 9 million imports annually.

Dirt Cheap Lighting for Africa

With only 26% of people in Africa having access to grid-based electricity, many of the continent’s



Ghanaian students use LED lighting at home

population rely on dangerous and increasingly expensive kerosene lamps and candles for lighting. A new fuel cell system, one of the winners of the World Bank’s May 2008 Lighting Africa competition, may be the solution. The system, developed by Harvard University students—four of whom are from Africa—harnesses energy produced by soil microbes as they break down organic matter such as animal waste and food scraps. The maintenance-free system, which is estimated to be cheaper than solar power, can generate enough energy to power LEDs and radios or to charge cell phones.



New Jersey football field undergoing testing for lead